Numb. 43.

PHILOSOPHICAL TRANSACTIONS.

Monday, *Januar*. 11. 166$^{8}_{9}$.

The Contents.

Divers Communications relating to the Queries *about* Vegetation, *formerly publiſht. Anſwers to ſome of the* Queries *heretofore recommended to Sir* Phil. Vernatti *in* Java Major. *A Summary Account of the General Laws* of Motion *by Dr.* John Wallis, *and Dr.* Chriſtopher Wren. *An Account of two Books:* I. *HISTORIA CÆLESTIS Obſervationum Vicennalium TYCHONIS BRAHE* II. *ANDR. TACQUET Opera Mathematica.*

Some Communications,

Relating to the Queries *about* Vegetation, *publiſh'd in Numb.* 40 *of theſe* Tracts.

THe Argument of *Vegetation* is exceeding noble, largely uſefull, and worthy to be expos'd to publick conſideration, and a general and accurate diſcuſſion; to the end, that where Obſervations are uncertain, and Experiments fickle, or failing, or caſual, the various Track or operation of Nature may be the better diſcover'd by the greater ſtore of confronting Trials and Obſervations. 'Tis for this Reaſon, that we not onely ſuggeſt and diſperce *Inquiries* upon this important Subject, but are alſo ready to impart ſuch Informations, as we receive from the Curious and Inquiſitive of what they have experimented and obſerved therein. At the preſent we ſhall inſert here, what hath been communicated (upon the *Queries* formerly publiſht) by thoſe two Worthy and Obſerving perſons Dr. *J. Beale*, and Dr. *Ezerel Tonge*.

To the 1. Dr. *B.* It will be difficult to enumerate all the Vegetables that will grow the wrong end ſet downwards in the ground. To mention ſome, beſides thoſe mention'd in that *Query* (*viz. Elders* and *Briars*) there are *Sallies*, *Willows*, the *Black-Elder, Vines*, and moſt *Shrubbs*; two or three of their joynts being cover'd in the mould, and the Stem cut off near the overmoſt Joynt, which ſhould be half cover'd in the mould, and the mould ſomewhat raiſed, as it ſpirts out and grows. Dr. *Tonge* agrees, ſaying, that *Curran* Trees, and ſuch like, as are of a ſoft wood, and quick growers, ſeem moſt apt to this improvement.

To the 2d. *Dr. B.* That the branch of a Plant, being laid in the Ground, whilſt yet growing on the Tree, and there taking root, being cut off whilſt ſo growing, will grow on both ends, if it be well rooted in the Propagation; and the like care had of the laſt knot or joynt, as was before preſcribed. Dr. *T.* ſaith, that Layers of thoſe Trees, mentioned in the former *Query*, will grow on both ends, and aptly parted when they have ſpread roots both wayes, make two plants out of each Layer.

To the 3d. *Dr. B.* In the *Tapping* of Trees, the juice certainly aſcends from the root, and after 'tis concocted to partake of the nature of the Plant (which feeds as well on the Air, as the juice furniſh'd through the root) it deſcends (as the Liquor in a *Limbec*) to the orifice, whence it iſſues. *Ratray*, the learned *Scot*, affirms, that he had calculated experimentally, that the liquor, which may be drawn from the *Birch* in the Spring time, is equiponderant to the whole weight of the Tree, branches, roots, and all together: Whence he inferrs, that it deſerves our diligence, fully to enquire into the manifold benefits that may be made by the Tappings of all ſorts of Vegetables; ſome at the Roots, ſome in the Body, either from the Bark, or the Timber; ſome under the chief Branches (which is noted by *V. Helmont* to be the proper place for the juice of the Birch;) ſome from the Fruit, Kernel, Bloſſoms, Seeds, or Husks containing ſeeds; as Dr. *Harvy* had a way of filling his Silver-box with a purer ſort of Opium, taken from the *Husks* of *Poppy-ſeed*, being prickt after ſome time of exſudation and inſolation. The like whereof may be tried upon the *Male peony*, and other Plants of greateſt fame and vertue; as well for Gums, Colours, Odors, *&c.* as for famous Juices. Mr. *Evelyn* can acquaint you of a *Receipt*, which he had in *Italy*, as a Specifick againſt *Feavers* from the Tappings of the *Elme*. I hear as much praiſe from the *Oak*, for ſtopping the *Flux* of *Bloud* by the way of Urine, whether it proceeds from the imbecility of Nature, or from the defects in the Bladder, Reins, or other inward paſſages. Some ſay as much for the Juice of the *Alder* (though the *Dwarf-Alder* hath the higheſt praiſe) to cure or ſtop the *Dropſie*. And perhaps this large *Natural Limbec*, where it may be had, may ſometimes prove more effectual, than our little, Artificial, and more troubleſome *Diſtillations*. And the Congeniality of the Sun in his alternative viſits, and the aſſiduous intercourſe of the free Air, with the Spirit of the Plant yet living and growing, may have a more effectual influence for a Specific vertue, than we are apt to imagine. Though we cannot ſee nor hear the Lungs of Vegetables beating, yet we may ſometimes ſmell their Breath ſtrong enough, both to pleaſe and offend exceedingly; as in *Savin*, *Firrs*, *Cypreſs*, *Elder*, *Roſemary*, *Mirtles*, and generally in all Bloſſomers. And ſome that cannot be ſmelt by us, may yet have a very wholſome breath. One Experiment I will here beſtow on you. When both my hands were manacled for many years (and ſometimes my Armes alſo) with deep corroding *Teaters*; to the bluſh of my many friendly Phyſitians, and in deſpight of many of the beſt Medicines and Purgations, all was ſuddenly heal'd, and hath ſo continued theſe 20 years, by the application of the *Gum* of *Plum-trees* diſſolved in Vinegar. I muſt not forget to add, that I applyed *Vine-leaves*, and ſometimes open'd *Raiſins* to draw a moiſture from thoſe *Teaters* ſome few dayes before I uſed the *Gum*.

Dr. *T.* is of opinion, that *Sap* alwayes riſes, and never properly deſcends, having onely a kind of ſubſiding or recidivation, which he ſaith he cannot call a Circulation, nor reſemble to the motion of Liquors in a *Pellican*; but rather to the ſinking of Liquors in an *Alembec*, whilſt the thinner parts are forced over the helm; yet ſomewhat imitating the motion of

Blood in Animals, foraſmuch as it continually ſupplies the want and expence of Sap in the exterior parts, from the ſtock of the ſap in the Trunk, root, and branches. He underſtands it thus; That the Sap, neceſſary to the growth of the leaves, fruit, and upper branches, being diſpenſed and converted into the form neceſſary for thoſe purpoſes, when the Tree is fulleſt of Sap, in ſuch manner that the Sap in the innermoſt Coats feeds the innermoſt, and the ſap of the outward coats the outward parts, of Fruits, *&c.* that which remains in the Body betwixt the ſeveral coats, and betwixt the Bark and Body, begins to condenſe there alſo, firſt into a Gelly, and after into Wood, Bark, Roots, *&c.* according to the ſeveral places to which it hath ſubſided. And becauſe it condenſeth faſter in ſome parts than in others, according as they be higher or lower, (whether it be by heat or cold, or exhalation of thinner parts) the ſap condenſed above or below, filling leſs room, muſt needs cauſe the ſap, which is not yet condenſed, in appearance to deſcend or ſubſide, and to ſink as it were lower and lower in the pores of the Timber and *B*ark, *i. e.* to be leſs high, not deſcend from any place, to which it was formerly riſen, unleſs (as in *Blood-letting*) when ſome lower part is open'd, all the ſap above continually flowes thither, till the Tree be emptied, or the continual flux of the Sap (the natural *B*alſome of the Tree) heal the wounds, as that of the *B*lood does thoſe of the *B*ody; and ſo much quicker and eaſier, by how much the Air is more favorable, or is better kept out; which he obſerves for their direction, who are curious in *Inoculation*, as the ground of their ſucceſſes or miſcarriages.

The Trees obſerv'd by the ſame Dr. *T.* to run, are the *Vine*; the *Birch* plentifully, at body, branches, and roots; the *Walnut-tree*, at the roots and prun'd branches; ſome *Willows* and *Sallyes*, and ſome ſorts of *Maple*; the *Sycamore*, which is the greater *Maple* (ſome call it the *Plane*) at a gaſh made on the bark of his body, and at the root and branches; the *Poplar* and *Aſp*: The *Elme* and *Oake* are referr'd to tryal; concerning which laſt ſome Wood-men affirm, that in ſuch of them as are Wind-ſhaken, that have large hollowneſſes in their Armes and *B*odies, they have found great quantity of ſap in the cutting of them, whereof having drunk, they quenched their thirſt without any prejudice. To theſe add the *Whitting*, or *Quicking-tree*, (Lat. *Fraxinus Sylveſtris*, and by ſome *Fraxinus Cambro-Britanica*) which in its ſeaſon, as ſome affirm, will run pleanteouſly, and whence they would have us expect a ſoverain Drink againſt ſome ſtubborn diſtempers, eſpecially ſuch as are *Scorbutical* and *Splenetick*. I have kept (ſaith Dr. *T.*) ſome of the Juice of the Berries (which being expreſs'd ferments of it ſelf) theſe two years in Bottles, and it hath now the taſte of an auſtere Cyder: And I ſuppoſe from its gratefull ſmell, that it may be kept till it ripen and become a ſtrong Vinous Liquor. It is the Houſhold drink of ſome Families in theſe parts about *Wales* and *Herefordſhire*, and ſome out of Curioſity have brew'd ripe Berries with ſtrong Beer and Ale, and kept it till it tranſcended all other Beer in goodneſs.

Dr. *Tonges* attempts upon the *Poplar*, *Aſpe*, *Elme*, *Oake*, *Aſhe*, *Elder*, *Whitting-berry* or *Quicking-tree*, *Thorn*, *Buckthorn*, *Tile*, *Nut*, *Sloe*, *Briar*, *Bramble*, &c. have not ſucceeded; and he doubts, that they, and all Apples and Pears have ſome degree of Gumminess in their Juices, ſo that they will not run.

To the 4th *Query*, Dr. *B.* Apparently the ſap riſeth by the inward Bark, where you may ſee the quick begin, and where the Graft firſt incorporateth.

Dr. *T.* There are Circles obſerv'd in Trees, which are the diſtances of thoſe Films or Coats, by which the Tree receives its yearly increaſe in thickneſs. Through theſe, looking full of Circular Pores, the Sap ſeems to aſcend in the ſame manner between coat and coat, as between the Bark and the Body; and probably between the two outermoſt of theſe Coats, as large a quantity of Sap, as between the Bark and Body. Now the Aſcent of Sap is by all parts and pores of the Tree, in ſuch ſmall quantities, as can hardly be diſcerned, unleſs the Tree be quite ſaw'd off, eſpecially near the Root; for then it will appear, how it aſcends. In *Birches*, and ſuch like, the Sap iſſues very plentifully in all parts of the body, when they are cut down near the Root. And in other Trees that have Pith, as the *Willow*, &c. it may be obſerv'd, when they are ſaw'd aſunder near the Root, whether any Sap iſſues or no by the Pith?

The Bark is double outward and inward. The outward is dry, and in ſome Trees rough. The inner, is probably a ſuperadded new Coat of that years growth, or ſomething like it, between the nature of Wood and Bark. The ſap riſes within and without that ſuper added Coat.

From hence it may be more carefully inquired than hath been hitherto done. 1. Whether the more Circles there be in any Branch, the longer the Sap will aſcend into it? 2. Whether the fewer Circles there are in it, the ſooner the Sap ſubſides from it? 3. Whether a Branch (ſuppoſe) of three Circles, cut at *Spring*, the ſap aſcending, or another of the ſame bigneſs, will at *Michaelmas* following, if cut again, be found to have increaſed one or more Circles than it had in the Spring: and whether at Spring or Fall, or at other ſeaſon, it be found to have a Circle or half a Circle of Pricks next or betwixt the Barks, or a Circle of Wood next the inner Bark onely, or both? But here the Compariſon is to be made with diſtinction. For it muſt be inquired, Whether ſome Trees ſhoot new Tops every year until a certain Age, and after not? Whether ſome have the Circles in their Branches decreaſed from their Body to the extremity of the Branch in ſuch order, that (*e.g.*) an Apple-tree-ſhoot of this year hath one Circle of Pricks or Wood plac'd in the Graft of two years old, and that of two years growth will the next year have one Circle more then it had the year before? And whether this onely be till the Branch ſhoot no more Grafts, and whether then the uttermoſt Twig get any new Circles, or ſtand at a ſtay, being nouriſh'd onely, not augmented in bulk as to the appearance of the Circles? And whether an Augmentation be between every Coat, or upon the outward Coat onely? Here it ought alſo to be enquired, Whether the Circles of *pricks* do encreaſe till *Midſummer*, and the Circles of *wood* from after *Midſummer* till next *Spring*?

Further, to perfect the experiment about Sap, and to find, Whether it aſcends more or leſs in the prickt Circles of the Body, than in thoſe betwixt the Body and the Bark; let the Tree be firſt pierced with an Auger onely through the *Bark*, and the quantity of Sap it yields in an hour, exactly meaſur'd and weigh'd; Then at the ſame time let another hole be bored into the *Body* of the Tree above an inch and an half deep, and ſo round about on every ſide of the Tree, ſome deeper, and ſome ſhallower, with a good large Auger; and one quite through ſloaping. From which Experiment, after various tryals, may be found the difference of the Sap riſing on the *North* and *South*, and ſo likewiſe of that which comes from the Bark onely peel'd off, and that which aſcends in the inner part of the Tree. The weight alſo may be compared of that which iſſues from the Bark, with that, which iſſues from the Body. The internal Heart-ſap may alſo be drawn apart, by boring a ſmaller Auger-hole in the middle of a greater, and fitting it with a long pipe, adjuſted to that inner orifice. If no difference be found in theſe, the preſumption will be greater, that the difference of *Heart* (as when they call *heart* of *Oake*) and *Sap* in Timber is not from the plenty or ſcarcity of ſap, but from the ſeaſon of felling. This Interception of the *Heart-ſap* may have an effect analogous to the boring out the Heart.

To the 5th. Dr. *B.* ſaith; I anſwer Experimentally, That if a Circle be drawn round about any common Engliſh Tree, as *Oak*, *Elme*, *Poplar*, &c. by Inciſion to the Timber (how thin ſoever the Knife be) ſo that no part of the Rind or Bark to the very ſolid Timber be un-cut, the Tree will die from that part upwards. Onely the *Aſhe*, (of all that I could try) will grow on, and proſper notwithſtanding the inciſion. My Brother (*T. B.*) ſhew'd me ſome old and huge *Aſhes*, which were bared of the Bark by the Deer, from the root 4 feet upwards quite round; yet they had continued their growth many years, and ſome parts of the Bark, which were left in few places not ſo broad as the palm of my hand, had a freſh verdure more lively then the parts of the Bark which remain'd above the baring. Yet if ſome Inciſions by hackings be made, or if the Branches of ſome Fruit-trees (eſpecially the *Gennet-moyle*) be quite bared under a knot near the body of the Tree, and that knot and bare part be well cover'd with loame or good mould in *June*, that branch will not onely ſurvive, but will be apt to take root and become a young Tree of ſpeedy growth, if cut off below the baring, and ſet at a fit depth at the end of *Autumn*, or about *Candlemas* rather. Where ſuch tranſverſe hackings are made, or Contuſions in the Bark, many Vegetables are apt to gather knobs; and ſometimes ſmall branches will ſpirt out above, and ſometimes about the part contuſed. To get the *Gum* of *Plum-trees*, I have ſometimes wrench'd the branch, till the ſolid Timber hath crackt, and the Rind forc'd open in ſome parts; ſo leaving it to grow, but forc'd to continue in a poſture ſomewhat wreathed, it hath not fail'd to yield me ſtore of *Gum* next Summer.

Dr. *T.* A Branch, whoſe Bark of the breadth of about 2 or 3 Inches is taken off round towards the bottom, in ſome Trees, and particularly the *Lime-tree*, will live, and bear leaves for many years, and grow, as other branches, by means of the ſap aſcending through all the pores of the inner Coats, as was ſaid above to the 3d *Q.* And it ought to be well obſerved, in what other Trees this will hold, and eſpecially, whether it will not hold in all Trees, whoſe ſap runs not out very plentifully: for, in ſuch Trees, wherein there is a plentiful Iſſue of the Sap between the Bark and Body, probably the Branch will die; beſides, ſome Air, as that of *North* and *North-Eaſt*, preſently blaſts open'd Trees.

To the 6th. Dr. *B.* Concerning the Uſe of the *Pith* in Vegetables, as whether the Juyce aſcends or deſcends by it? It may be conſider'd, That my Anſwers above do import that the Juyce, which deſcends by Tapping, and which maketh the pulp or coat of any fruit, aſcends by the Bark or Rind of the Plant, not by the Pith. I now add (which I can affirm by many Experiments) that the *Pith*, and the Timber have ſome correſpondence with the *Seed* of the Plant, to conveigh an entire courſe of the ſame Spirits and nature from the *Root* to the *Seed*.

The Experiments themſelves, whereby the Worthy Doctor maketh this out, we muſt refer to another opportunity; as alſo his conſiderable Diſcourſe already in our hands, giving Inſtances to ſhew, That there is a peculiar Correſpondence, not onely between the Seed *and the* Pith, *Heart or Timber of Plants; but alſo between the* Bark *or* Sap *in the Bark, and the* Pulp *of the Fruit, or ſome encompaſſing* Coat *or Husk, or Cod, which contains the Seed.*

Dr. *T.* anſwers to the ſame *Q.* *Piths* are of a very different nature and ſubſtance. In the *Walnut*, is a multitude of *films* manifeſtly diſtant from one another. In others, as in *Elders* and *Briars*, 'tis a continued, ſoft, looſe, dry ſubſtance. In the *Walnut*, an obſervation may be made, by cutting a ſmall and young branch, which hath the largeſt pith, in *March*, to the Pith in ſome branches, and through it in others of the like bigneſs: Whether any Sap iſſues out or no by the *Pith*, will be found by the quantity of the Sap iſſuing from the one and the other compar'd.

The Obſervations alſo of the Effects of *Boring* and *Pegging* the Pith, are reſerv'd to the like tryal about the ſame time. But 'tis probable, that if the whole Pith be forc'd out, the place ſo bor'd will be fill'd with Sap, which will gelly there, and at length be converted into wood; as 'tis conceiv'd it does yearly between the aboveſaid films, coats, and in all the pores of the Body of the Tree, and in thoſe of the Bark proportionably. For, the Sap iſſuing from the *Birch*, cut down, turns into a white Gelly on the head of it; and likewiſe in thoſe holes that are bor'd in the body of the Birch about *March*, by which the Tree receives its growth in all its parts.

To the 7th. Dr. *Tonge*, The points or ends of the Roots being cut off, they will in proportion bleed as copiouſly, as the Branches, and probably more; certainly longer, becauſe there is greater plenty of juice aſcended above them, than the Branches, and conſequently more will iſſue by them, than by any part of the Tree, higher then them.

To the 9th. The ſame. Trees in their full growth, or near it, will probable yield more ſap.

To the 10th. The ſame. From the latter end of *January*, to the middle of *May*, Trees will bleed. Thoſe, that are ſaid to run *firſt*, are the *Poplar*, *Aſpe*, *Abele*, *Maple*, *Sicamore*; ſome, as *Willows*, and the *Birch*, tried by my ſelf, are beſt to tap about the middle of the ſecond ſeaſon; and the *Walnut* towards the latter end of *March*. They generally bleed a full Month in the whole. Mr. *Midford* of *Durham*, a very expert Gatherer and Preſerver of Saps, affirms, that the Saps of the *Poplar* and *Aſpe* riſe ſo briskly in *January*, that they will bleed before the end of that Month. The *Sycamore* will run in hard froſt, when the Sap freezes, as it drops.

Fiat Experimentum, Since we are now in that very ſeaſon, to ſee whether that early aſcent is to be imputed to the forwardneſs of the year, or not? Let it alſo be obſerved, whether the Sap aſcends in *Oak* and *Elme*, at any time in this month of *January*; and likewiſe, which of theſe three, the *Maple*, *Sally*, or *Willows*, be the moſt early in yielding of Sap?

And to obtain an Univerſal and Accurate knowledg of the nature of Sap in Trees, its properties and accidents; Obſervations and Tryals muſt be made by a *Number* of men, that have leiſure to attend that buſineſs daily; which are to examine concerning every Tree;

1. Its Age, Soyle, Situation, *&c.* the variety of the Aſcent of the Sap depending thereon, as on the nature of the Tree it ſelf.
2. The different time of Aſcent in Branches, Body, Roots; and of its diſtilling from cut branches; from roots, not from branches.
3. The Seaſons and differences of the time of the year, month and day, in which theſe accidents happen or ceaſe; whereby it may appear, what to determine concerning them: And particularly, whether that conjecture be well-grounded; which ſuppoſes, That Sap does not deſcend from Trees otherwiſe than by jellying ſo as to fail above, whilſt there is yet plenty below; as ſeems to be manifeſt by the running in the Roots, when it ceaſes in the Branches.

It were alſo not amiſs to obſerve, Whether in any Trees, the Sap as to its aſcendings, keeps time with the Suns entrance into this or that Sign?

To the 11th. *The ſame.* The beſt time of the day for Tapping, is about Noon. In the latter ſeaſon, when Sap is not very plenteous in Trees, they will neither run morning, nor evening, nor probably at any time of the night; but when they are very full of Sap, and emptied but by ſmall vents, the Sap may run night and day, till exhauſted; but never in large vents.

Quere, Whether this Obſervation may not give light to that Opinion, which holds, that the Aſcending of the Sap depends upon the Preſſure or Pulſion of Heat, ſtriking the Earth, and thereby driving the moiſture of the Earth into the Root?

To the 12th. *The ſame.* Trees afford no juice at all (that has been obſerv'd) in *Autumne*.

To the 13th. *The ſame.* Rain being ſcarce, the juice will be ſcarcer. Plenty of Rain can onely give ſuch plenty of Sap, as the pores will admit.

The Anſwers to the reſt of the Queries *we reſerve for another Month, leaſt theſe Papers be altogether filled with one ſubject. Thoſe that have been deliver'd here from* Dr. Tonge *were for the moſt part taken out of his Letters to Sir* R. Moray, *in* January, February, March, Aprill, 1666; *at which time he had newly made Experiments about Saps; and are now, after conference with him, accommodated to the* Queries *formerly made publick.*